course. So it is natural to assume that the inertia of any body is proportional to the force (F) required to give it unit acceleration, or since acceleration is proportional to force and since the acceleration produced by unit force would be $1/F$, this is equivalent to assuming that inertia is inversely proportional to the acceleration produced by unit force.

12. *Inertia of Different Volumes of Iron.*—(1) Two carriages carrying two or three equal volumes of iron, accelerated toward each other by a stretched rubber band.

(2) Atwood's machine, same force, different volumes of iron.

Conclusion: Acceleration is inversely proportional to the volume of iron for the same force; therefore inertia is directly proportional to the volume of iron or to the amount of iron.

13. *Inertia of Equal Volumes of Various Substances.*—Assume that two bodies have the same inertia when the same force gives them the same acceleration. Using the same apparatus as in §12, we find that the ratio of the inertias or masses of any two bodies is equal to the ratio of their weights (at a given point on the earth).

14. *Units of Mass.*—Kilogram, gm., pound.

15. *Falling Bodies.*—Since the force acting is proportional to the mass of each body, the acceleration must be the same for all. This conclusion agrees with experiment.

C. Fundamental Law of Mechanics

16. *Summary:*

With same mass: $a_1 : a_2 = F_1 : F_2$.
With same force: $a_1 : a_2 = m_2 : m_1$.
With same acceleration: $m_1 : m_2 = F_1 : F_2$.
Combining these: $m_1 a_1 : m_2 a_2 = F_1 : F_2$.

17. *Fundamental Law.*—When any body is acted on by an unbalanced force, the acceleration produced is in the direction of the force, is proportional to the force and is inversely proportional to the inertia of the body acted upon.

18. *Gravitational Units of Force.*—Kg. wt., lb. wt. The units we have been using. If force is measured in kg. wt., mass in kg., and acceleration in cm. per sec. per sec. then

$$a = gF/m,$$

where g is the acceleration of gravity. The same equation holds for lbs. wt. and lbs. and ft. per sec. per sec. Variation of g with distance from center of earth. Units not absolute.

19. *Absolute Units of Force.*—Dyne, poundal. Independent of gravity. Simpler equation $F = ma$.

20. *Application to Various Special Cases.*—Atwood's machine, inclined plane, etc.

21. *Definition and Discussion of Momentum, Impulse, Work and Energy.*

I shall be very grateful for any suggestions in regard to the above outline, especially from those who are willing to concede that a departure from our present dogmatic method of presentation is advisable.

GORDON S. FULCHER
WISCONSIN UNIVERSITY
April 1, 1915

GET THE UNITS RIGHT

PROFESSOR A. GRAY in a recent lecture on Kelvin's work in gyrostatics, says:

> It is always a good thing to get down to numbers and it is a most healthful mental discipline to be forced to *get the units right.*

The force of this remark is apparent in following the discussion in SCIENCE relative to the best expression of the fundamental equation in mechanics. Professor Kent criticizes Professors Huntington and Hoskins, objecting to the form of the equation $F = ma$. He rightly says:

> The equation is not true in the ordinary English system (foot-pound-second) until it is hybridized by valuing either F or m in some other unit than pounds (poundal or gee-pound) or a in gravitals (instead of feet) per second per second (1 gravital $= 32.174$ feet) or else the letter m is explained as not being quantity of matter in pounds but only the quotient or ratio W/g. Neither is it true in the metric kilogram-meter-second system. . . . It is of course true in the dyne-centimeter-gram-second system but this system is only used in higher physical theory and it should not be inflicted on young students.[1]

[1] SCIENCE, Vol. XLI., No. 1055, p. 424.

Now what is the difficulty with the dyne-C.G.S. system and why not inflict it on the young? What is the present system, if not an infliction?

At Blue Hill Observatory we have for some time been expressing temperatures in degrees absolute, pressures both atmospheric and vapor, in kilobars or kilodynes, and rainfall in millimeters. Dr. Shaw, of the British Meteorological Office, has since May 1, 1914, published rainfall values in the daily weather report in millimeters and beginning January 1, 1915, the millimeter is used in the weekly and monthly weather reports. In nearly every part of the world except the United States the millimeter has supplanted the inch as the unit of rainfall measurement. Of course it will be adopted here before long. As Shaw points out, aside from the advantage of using a unit generally adopted, the unit of rainfall 0.01 inch used to define a rain day has been most unsatisfactory. A fall of 1 mm. (0.04 inch) is a much fairer definition and as a matter of fact we have had to publish this in addition to the former.

From the point of view of the engineer, the use of the millimeter facilitates computation and realization of the amount of water available over a given area. A millimeter of rainfall means a liter of water per square meter.

Any one who has lived in the western part of the United States and recalls the various miners' inches for measuring water depth and flow will realize that it would be far from being an infliction to have the C.G.S. units come into general use in engineering practise.

It is not so difficult to break away from the old units as may be imagined. A year's constant use of the C.G.S. units makes one feel like saying, when reading of inch measurements, "Inch, inch? Where have we met that term before?"

Alexander McAdie
Harvard University

A SPURIOUS CASE OF MULTIPLE HUMAN BIRTHS

In the *Boston Medical and Surgical Journal* for September 26, 1872, under the head of Medical Miscellany occurs the following item:

Eight Children at a Birth.—On the 21st of August, Mrs. Timothy Bradlee, of Trumbull County, Ohio, gave birth to eight children—three girls and five boys. They are all living, and are healthy but quite small. Mr. Bradlee was married six years ago to Eunice Mowery, who weighed 273 pounds on the day of her marriage. She has given birth to two pairs of twins, and now eight more, making twelve children in six years. Mrs. Bradlee was a triplet, her mother and father being twins, and her grandmother the mother of five pairs of twins.

This case has been quoted often both in general texts, such as Gould and Pyle, "Anomalies and Curiosities of Medicine," 1897, p. 153, and in special papers, such as Wilder, *American Journal of Anatomy,* Vol. 3, p. 393, 1904. From the Prussian statistics gathered by Veit, it has been shown that twins occur on the average once in 88 births, triplets once in 7,910 births and quadruplets once in 371,126 births. Cases of five or six children at a birth are well authenticated, but are so rare that no statistical statements concerning them can be made. Gould and Pyle, in commenting on these instances, declare that all cases thus far reported of more than six children at a birth are to be regarded as of very doubtful value. To this category belongs that of Mrs. Bradlee already quoted. As this instance is of comparatively recent origin, it seemed possible to learn something of its authenticity. A letter was therefore addressed to the county clerk of Trumbull County, Ohio, inquiring about the case, and through the courtesy of that official the following reply was received.

M. B. Tayler,
Clerk of Courts,
Trumbull County
Warren, Ohio, March 30, 1914

Mr. G. H. Parker,
Cambridge, Mass.

Dear Sir: I reply to your letter of the 24th inst., in regard to the item in the medical journal, would say that after inquiry I am informed that there is no truth in the statement. It seems that a practical joker of those days went into one of the newspaper offices here and set up an article which he succeeded in having printed in one or two copies of the paper and then took the article out and distributed the type in their proper places, and se-